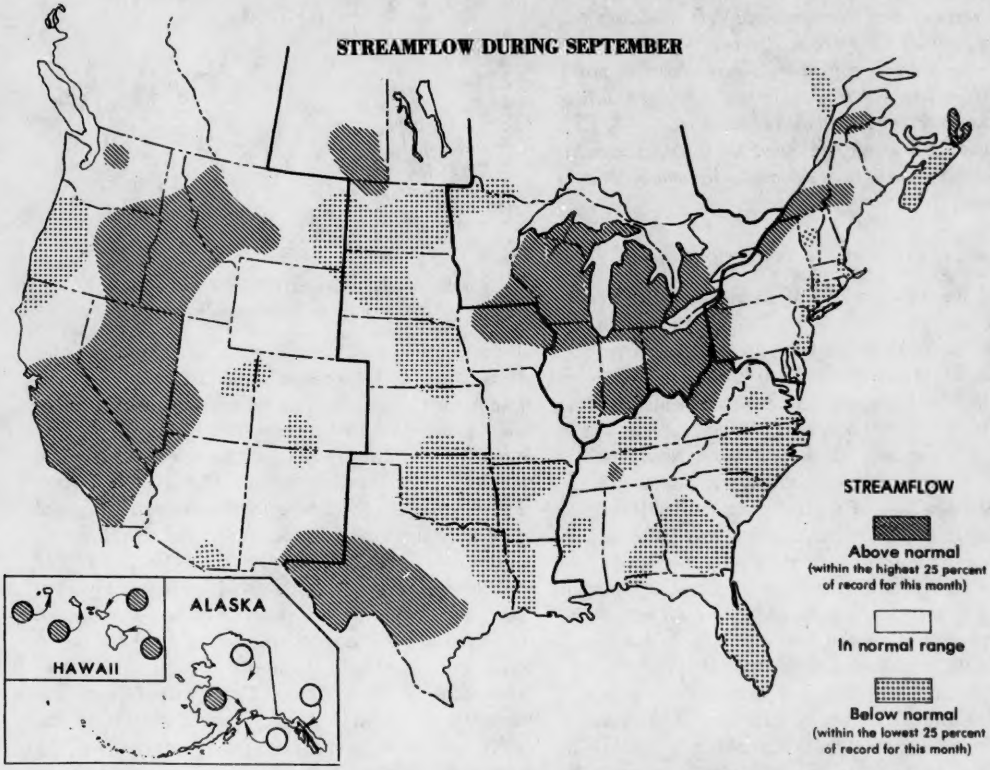
WATER RESOURCES REVIEW for SEPTEMBER 1980

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH



STREAMFLOW AND GROUND-WATER CONDITIONS

Streamflow generally decreased in southwestern Canada, Nevada, Wyoming, most parts of the Ohio River Valley and the Midcontinent Region, and throughout most of the Northeast and Southeast Regions. Monthly mean flows generally increased in Michigan, Missouri, New Hampshire, North Dakota, Ontario, Vermont, Washington, and Wisconsin, and were variable elsewhere.

Monthly mean discharges remained in the above-normal range in parts of Nova Scotia, Quebec, California, Iowa, Maine, New York, Nevada, Tennessee, Texas, Utah, West Virginia, and most parts of the Western Great Lakes Region. Monthly and/or daily mean flows were highest of record for the month in parts of Alaska, Michigan and Utah. Flooding occurred in Alabama, Minnesota, Texas, and Wisconsin.

Below-normal streamflow persisted in parts of Arizona, Connecticut, Oregon, Utah, Vermont, and in parts of each State in the Midcontinent and Southeast Regions except Iowa, Kentucky, Missouri, and West Virginia. Monthly mean flows were lowest of record for September in parts of Louisiana. Water-use restrictions imposed by many cities and towns in Arkansas, Kansas, New Jersey, Oklahoma, and Texas continued in effect during September.

Ground-water levels continued to decline seasonally in the Northeast Region; levels were again near normal in most of the region. In the Southeast Region, declining levels prevailed, and levels were mixed with respect to average except in Virginia, where they were below average, and in Florida, where they were average or below average. In the Western Great Lakes Region, levels declined or held steady in Indiana, and declined in Ohio but continued above normal. Trends were mixed in other States and levels were above and below average. Mixed trends generally prevailed in the Midcontinent Region, and levels were above and below average except in Kansas and Arkansas, where they were below average. In the West, levels rose in Washington and in Utah, and mostly rose in Idaho; trends were mixed in other States. Levels were below average in Washington and Arizona, and above and below average elsewhere in the region.

New high ground-water levels for September were recorded in southern California and Nevada, and a new alltime high level occurred in Kentucky. New September lows were noted in Arkansas, Idaho, Louisiana, Tennessee, and Texas, and a new alltime low was reached in Georgia.

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

Streamflow generally decreased seasonally in Connecticut, Maryland, Massachusetts, and New Jersey, increased seasonally in New Hampshire and Vermont, and was variable elsewhere in the region. Monthly mean flows remained above the normal range in parts of Nova Scotia, Quebec, Maine, New York, and Pennsylvania. Mean flows remained in the below-normal range in parts of Connecticut and Vermont, and decreased into that range in parts of Nova Scotia, Quebec, New Jersey, and New York. A water emergency was declared in northeastern New Jersey during the month when contents of several key reservoirs continued to decrease.

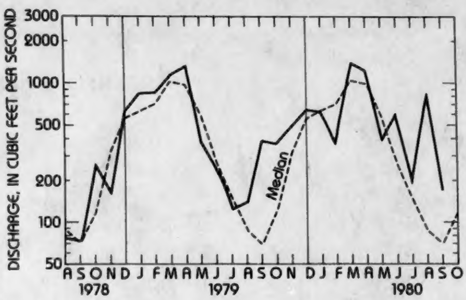
Ground-water levels continued to decline seasonally. End-of-month levels were again near normal in most of the region.

STREAMFLOW CONDITIONS

In the metropolitan area of northeastern New Jersey, a water emergency was declared during the month as a result of water level declines in several key reservoirs. Contents of Wanaque Reservoir in the Passaic River basin decreased sharply and at monthend stood at 47 percent of normal maximum. Water rationing was in affect in a 6-county area of northern New Jersey at monthend. In the north-central part of the State, monthly mean flow of South Branch Raritan River near High Bridge continued to decrease seasonally but remained in the normal range at 83 percent of median. In southern New Jersey, mean flow of Great Egg Harbor River at Folsom also continued to decrease seasonally, was 59 percent of median, and was in the below-normal range for the first time since February 1980.

In Maryland and Delaware, streamflow decreased seasonally throughout the bi-State area but was within the normal range at all index stations in September. In central Maryland, runoff for both the water year and the period April to September at Seneca Creek at Dawsonville were above the normal range for the 3d consecutive year.

In northwestern Pennsylvania, where monthly mean flow in August in Oil Creek at Rouseville was highest of record for the month, flow decreased in September but remained in the above-normal range for the 2d consecutive month and was 242 percent of median. (See graph.) Also in western Pennsylvania, monthly mean discharges of Monongahela River at Braddock and Allegheny River at Natrona reflected high carryover flow from August and remained in the above-normal range for the 6th and 4th consecutive months, respectively. In the Susquehanna River basin in eastern Pennsylvania, monthly mean flow, as measured at Harrisburg, decreased seasonally to 75 percent of median but remained in the normal range for the 3d consecutive month.



Monthly mean discharge of Oil Creek at Rouseville, Pa. (Drainage area, 300 sq mi; 777 sq km)

Upstream, in New York, monthly mean discharge of Susquehanna River at Conklin decreased sharply to 56 percent of median as a result of much below-normal precipitation but was within the normal range for the 2d consecutive month. In the northern part of the State, mean flow of West Branch Oswegatchie River near Harrisville increased seasonally, was almost twice the median flow for September, and remained in the above-normal range for the 2d consecutive month. In the

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southeastern part of the State, streamflow receded seasonally, with only two storm events breaking the trend. The only area of unusually low streamflow was in Rockland County, where Mahwah River near Suffern decreased to flow values reached in 1964. Recurrence intervals of daily low flows at several gaging stations in the area was about 2 years. On Long Island, flow of Massapequa Creek at Massapequa decreased to one-half the median flow for September and was below the normal range for the first month since February 1980.

In adjacent Connecticut, streamflow decreased sharply at all index stations and was below the normal range except in the northeastern part of the State where flow of Mount Hope River at Warrenville decreased to 63 percent of median but remained in the normal range. In the northwestern part of the State, the monthly mean discharge of 0.87 cfs at Burlington Brook near Burlington (drainage area, 4.13 square miles) was only 0.1 cfs greater than the minimum flow for September reached in 1964. Runoff for both the water year and the period April to September was in the normal range for all index stations in Connecticut, Massachusetts, and Rhode Island.

In Vermont, monthly mean flow of Dog River at Northfield Falls increased seasonally but remained in the below-normal range for the 2d consecutive month and was 71 percent of median. Annual mean discharges for the 1980 water year were below the normal range in Vermont and central New Hampshire and yearly runoff at the index station, Batten Kill at Arlington, Vermont was the 2d lowest for period of record that began in October 1928.

In central Maine, mean flow of Piscataquis River near Dover-Foxcroft decreased but remained in the above-normal range as a result of runoff from rains at midmonth. Elsewhere in the State, monthly mean flows at index stations increased, contrary to the normal seasonal pattern of decreasing flows, but remained in the normal range. Runoff for the 1980 water year and the period April to September was below the normal range at all three index stations in Maine.

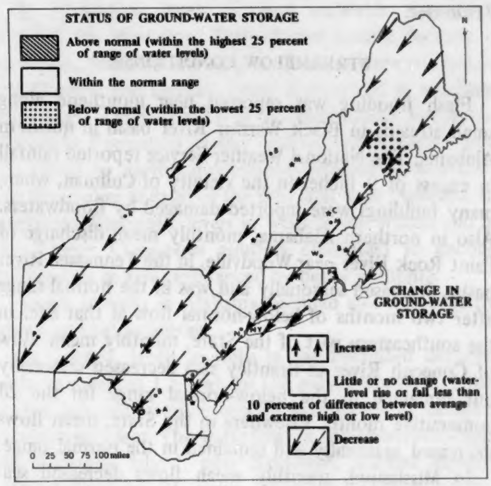
In central and southern Nova Scotia, monthly mean discharges of St. Mary's River at Stillwater and LaHave River at West Northfield decreased sharply to 13 and 25 percent of their respective median flows, and were below the normal range. By contrast, in the northern part of the Province, flow of Northeast Margaree River at Margaree Valley also decreased but remained in the above-normal range and was 220 percent of median.

In New Brunswick, mean flows at index stations decreased but averaged 166 percent of the September median and were within the normal range.

South of the St. Lawrence River in Quebec, monthly mean discharges of St. Francois River at Hemmings Falls and Matane River near Matane increased seasonally, were above the normal range, and were 217 and 354 percent of median at the respective sites. By contrast, in eastern Quebec, but north of the St. Lawrence River, mean flow of Outardes River at Outardes Falls decreased sharply to only 58 percent of the September median flow and was below the normal range. Elsewhere in the Province, mean flows at index stations generally decreased but were within the normal range.

GROUND-WATER CONDITIONS

Ground-water levels continued to decline seasonally in nearly the entire region. (See map.) Levels at end of month were once again mostly near normal for this time of year, but below-normal levels were reported in some wells in south-central Maine and in a few other scattered locations.



Map shows ground-water storage near end of September and change in ground-water storage from end of August to end of September.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow increased in parts of Florida, North Carolina, South Carolina, and Tennessee, but decreased seasonally in all other parts of the region. Monthly mean flows remained above the normal range in parts of Tennessee and West Virginia. Mean flows remained in

the below-normal range in parts of Alabama, Florida, Georgia, Kentucky, North Carolina, South Carolina, and Virginia, and decreased into that range in parts of Mississippi. This was the 3d consecutive month of mean discharge in the below-normal range in parts of Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee, and the 7th consecutive month of above-normal mean flow in part of Tennessee. Flooding occurred in Alabama.

Ground-water levels generally declined in the region, but were mixed with respect to average. A new alltime high level occurred in Kentucky, a new alltime low in Georgia, and a new low for September was recorded in Tennessee.

STREAMFLOW CONDITIONS

Flash flooding was reported near monthend along small streams in Black Warrior River basin in northern Alabama. The National Weather Service reported rainfall in excess of 9 inches in the vicinity of Cullman, where many buildings were reported damaged by floodwaters. Also in northern Alabama, monthly mean discharge of Paint Rock River near Woodville, in the Tennessee River basin, decreased seasonally and was in the normal range after two months of below-normal flow at that site. In the southeastern part of the State, monthly mean flow of Conecuh River at Brantley also decreased seasonally but remained in the below-normal range for the 2d consecutive month. Elsewhere in the State, mean flows decreased seasonally and remained in the normal range.

In Mississippi, monthly mean flows decreased seasonally in all parts of the State and were in the normal range except in Big Black River where mean discharge near Bovina was below the normal range and was only 43 percent of median. This was the first month since November 1978 in which mean flow was below the normal range at this index station.

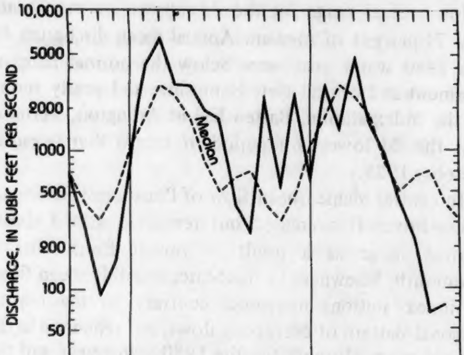
In western Tennessee, monthly mean discharge of Buffalo River near Lobelville continued to decrease seasonally but remained in the above-normal range for the 7th consecutive month and the 16th time in the past 18 months. In the east-central part of the State, mean flow of Emory River at Oakdale increased, contrary to the normal seasonal pattern, and was in the normal range after 3 consecutive months of flow in the below-normal range. In north-central Tennessee, monthly mean flow in Harpeth River near Kingston Springs decreased sharply, was below the normal range, and was only 34 percent of the median discharge for the month. In the eastern part of the State, mean flows were variable and were less than median, but remained within the normal range.

In southern Kentucky, monthly mean flow of Green River at Munfordville continued to decrease seasonally, remained in the below-normal range for the 3d consecutive month, and was only 47 percent of the September median discharge. In the northern part of the State, mean flow of Licking River at Catawba also decreased seasonally and was less than median, but was in the normal range for the 3d consecutive month.

In West Virginia, monthly mean flows decreased seasonally and were in the normal range except in the southwestern part of the State, where mean discharge of Kanawha River at Kanawha Falls was 1½ times the September median flow and remained in the above-normal range.

Similarly in Virginia, mean flows decreased seasonally and were in the normal range except in the central part of the State, where monthly mean discharge of Slate River near Arvonia decreased into the below-normal range and was only 43 percent of median.

In the eastern Piedmont of North Carolina, where mean flow of Deep River at Moncure in August was only 9 percent of median and was lowest of record for the month, mean discharge increased, contrary to the normal seasonal pattern, but remained below the normal range for the 3d consecutive month. (See graph.) Also in the eastern Piedmont, mean flow of Cape Fear River at William O. Huske Lock near Tarheel increased, contrary to the normal seasonal pattern, but remained in the below-normal range.



Monthly mean discharge of Deep River at Moncure, N.C.
(Drainage area, 1,410 sq mi; 3,650 sq km)

In northeastern South Carolina, monthly mean flow of Pee Dee River at Peedee continued to decrease seasonally and remained in the below-normal range. In the adjacent basin of Lynches River, monthly mean discharge at Effingham increased, contrary to the

normal seasonal pattern, but remained below the normal range for the 3d consecutive month. In the central part of the State, mean flow of North Fork Edisto River at Orangeburg decreased seasonally but remained within the normal range for the 5th consecutive month.

In eastern Georgia, monthly mean flow of Altamaha River at Doctortown continued to decrease seasonally, was about half the median discharge for September, and remained below the normal range. In the Suwannee River basin in southern Georgia, mean flow of Alapaha River at Statenville also decreased seasonally, was only 16 percent of median, and remained in the below-normal range for the 3d consecutive month. In the Apalachicola River basin in western Georgia, monthly mean discharge of Flint River near Culloden continued to decrease seasonally and remained below the normal range for the 3d consecutive month. In the extreme northern part of the State, mean flow of Etowah River at Canton also continued to decrease seasonally, was slightly less than median, and remained within the normal range for the 3d consecutive month.

In the Florida Panhandle, monthly mean flow of Apalachicola River at Chattahoochee decreased seasonally but remained within the normal range for the 4th consecutive month. By contrast, mean flow of Shoal River near Crestview decreased, contrary to the normal seasonal pattern, was only 59 percent of median, and was in the below-normal range for the first time since July 1977. In the northeastern part of the State, monthly mean discharge of Suwannee River at Branford also decreased, contrary to the normal seasonal pattern, but remained in the normal range for the 4th consecutive month. In the west-central part of peninsular Florida, mean flow of Peace River at Arcadia increased seasonally but remained in the below-normal range for the 3d consecutive month. Similarly, in the east-central part of the peninsula, mean discharge of St. Johns River near Christmas remained below the normal range for the 3d consecutive month. In southern Florida, monthly mean flow of Fisheating Creek at Palmdale increased seasonally and was only 28 percent of median but was below the normal range for the 3d time in the past 4 months. The usual sharp increases in September monthly mean flows resulting from runoff during tropical storms did not materialize this year in Florida.

GROUND-WATER CONDITIONS

In West Virginia, levels declined in most parts of the State. Levels were below average in the east-central one-fourth of the State but were above average elsewhere.

In Kentucky, levels declined seasonally but were generally above average except in places where levels in shallow aquifers declined in response to locally severe drought conditions. A new alltime high level, despite a slight net decline during the month, was recorded in the key well in Louisville in 34 years of record.

Levels in Virginia declined moderately and were slightly below average. The level in the Tyler well in Louisa County was below average for the first time in 20 months.

In western Tennessee, the artesian level in the key well in the 500-foot sand near Memphis rose slightly but was at a new September low in 39 years of record.

Levels declined statewide in North Carolina. They were above long-term averages in the mountains and in the Piedmont, and below average in the Coastal Plain.

In Mississippi, levels declined statewide. Levels in wells in the Mississippi River alluvial aquifer declined 1 to 4 feet. Seasonal late summer declines were reached in the Miocene and Graham Ferry Formations in southern Mississippi. Levels in wells in the Sparta Sand, and in the Cockfield Formation in the Jackson metropolitan area continued to decline moderately, establishing new lows for September at most of the sites that were observed. In northern Mississippi, levels in wells in the Wilcox and in the Upper Cretaceous aquifers continued to decline moderately in areas influenced by heavy pumping.

Levels in wells in Alabama declined and were slightly above and below average.

In Georgia, levels in wells in the Piedmont declined only as much as 1.5 feet. In the coastal counties, levels in the principal artesian aquifer held steady or declined as much as 3 feet. The water level in the observation well on Cockspur Island, near Savannah, reached another alltime low in 24 years of record. Levels in the water-table aquifer declined to 5.2 feet below average. In the southwest, levels held steady.

Levels declined in most areas in northern Florida and in the central peninsular part of the State during September. Levels declined 1.2 feet at Tallahassee, 1.5 feet in Pensacola, and 1.7 feet near Tampa. At Jacksonville, the level in the key well held steady, but rose 1.1 feet in the well near Mulberry in west-central Polk County. In southeast Florida, levels ranged from 0.5 foot above to 1.6 feet below those of last month; the greatest declines occurred in Palm Beach and Broward Counties. End-of-month levels ranged from about average to 1 foot below average.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow increased in Ontario, Michigan, and Wisconsin, decreased in Indiana, and Ohio, and was variable in Illinois and Minnesota. Monthly mean flows

remained in the above-normal range in parts of Ontario, Illinois, Indiana, Michigan, Ohio, and Wisconsin, and were highest of record for the month in parts of Michigan. Mean discharges remained in the below-normal range in parts of Illinois and Minnesota. Flooding occurred in Minnesota and Wisconsin.

Ground-water levels declined or held steady in Indiana, and declined in Ohio but continued above normal. Trends were mixed in other States and levels were above and below average.

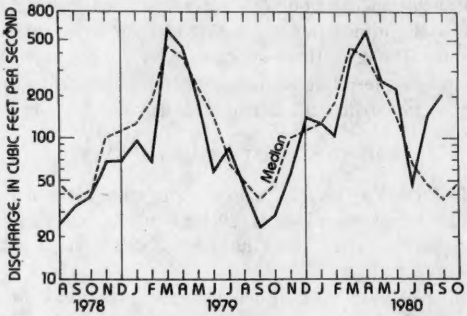
STREAMFLOW CONDITIONS

Moderate flooding occurred during the period, September 21–23, in the Black River basin in western Wisconsin as a result of rapid runoff from 3 to 4 inches of rain in a few hours falling on nearly-saturated ground. In the headwaters of Black River, the peak discharge of 29,000 cfs, as measured at Neillsville (drainage area, 756 square miles), occurred on September 21. Downstream near the mouth, the peak discharge of 46,000 cfs on September 23 at Black River near Galesville (drainage area, 2,120 square miles) was about 20,000 cfs less than the peak of record that occurred at that site on April 1, 1967. The recurrence interval for the September peak discharges at both sites was about 18 years. The National Weather Service reported severe flash flooding in Buffalo, Jackson, La Crosse, and Trempealeau Counties in southwestern Wisconsin on September 21. Numerous highways and bridges were reported to have been washed out in the southwestern part of Jackson County. In the northwestern part of the State, monthly mean flow of Jump River at Sheldon (drainage area, 574 square miles) increased sharply as a result of the increased runoff September 21–23. The monthly mean discharge of 1,830 cfs was 15 times the median discharge for the month, and was the 4th highest for September in 65 years of record. Also in the northwestern part of the State, mean flow of Chippewa River at Chippewa Falls increased into the above-normal range and was 4 times the September median discharge. In west-central Wisconsin, mean flow of Trempealeau River at Dodge was highest for September since records began in 1934. In the extreme southeastern part of the State, the monthly mean discharge of Fox River at Wilmot was the 2d highest for September since records began in 1940. Mean flow at this station during August also was 2d highest for that month in the 40-year record.

In extreme southeastern Minnesota, flooding caused by rapid runoff from intense rainfall September 20 resulted in estimated damage of $2 million to public and private property along small tributaries to the Mississippi River between Winona and La Crescent. The peak discharge of 17,900 cfs in Root River near Houston (drainage area, 1,270 square miles), near La Crescent, on September 21 was about 2 times the mean annual flood for that site, and the monthly mean discharge of 1,510 cfs was 2d highest for September in 57 years of record. Also, the monthly mean discharge of 238 cfs in South Fork Root River near Houston (drainage area, 275 square miles) was highest for September in 27 years of record. By contrast, in the extreme northern part of the State, where monthly mean flow of Rainy River at Manitou Rapids was lowest of record for each month from June through August, mean discharge increased, contrary to the normal seasonal pattern, but remained in the below-normal range for the 5th consecutive month and was only half the median discharge for September. Also in northern Minnesota, the monthly mean discharge of 5 cfs in Roseau River below State Ditch 51, near Caribou (drainage area, 1,570 square miles) was the 2d lowest for September in 61 years of record, and was only 12 percent of median. In contrast, the mean flow of St. Louis River at Scanlon (drainage area, 3,430 square miles), also in the northern part of the State, increased sharply to 1,800 cfs and was 1½ times the median discharge for September for that site. Elsewhere in the State, monthly mean flows generally increased and were in the normal range.

In western Ontario, monthly mean discharge of English River at Umfreville increased sharply, contrary to the normal seasonal pattern, and was in the normal range after 5 consecutive months of flow in the below-normal range. In the eastern part of the Province, north of Lake Huron, mean flow of Missinaibi River at Mattice increased seasonally and was in the normal range but was only 58 percent of the September median discharge. In extreme southeastern Ontario, mean flow of Saugeen River near Port Elgin also increased, contrary to the normal seasonal pattern, was almost 2 times the September median flow, and remained above the normal range for the 3d consecutive month.

In the southern part of Michigan's Lower Peninsula, flow of Red Cedar River at East Lansing (drainage area, 355 square miles) continued to increase, contrary to the normal seasonal pattern, remained in the above-normal range, and the monthly mean discharge of 206 cfs was the highest for September in 50 years of record. This was the 2d consecutive month of record-high monthly mean flow at this index station. (See graph.) In the



Monthly mean discharge of Red Cedar River at East Lansing, Mich. (Drainage area, 355 sq mi; 919 sq km)

(Continued on page 8.)

Provisional data: subject to revision

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie 1.57; Ontario, 1.22.)

Lake	September 30, 1980	Monthly mean, September		September		
		1980	1979	Average 1900–75	Maximum (year)	Minimum (year)
Superior . . . . (Marquette, Mich.)	601.12	600.95	601.46	601.02	601.93 (1916)	599.46 (1926)
Michigan and Huron . . . . (Harbor Beach, Mich.)	579.56	579.68	579.88	578.47	580.76 (1952)	575.94 (1964)
St. Clair . . . . (St. Clair Shores, Mich.)	575.10	575.19	575.08	573.51	575.70 (1973)	571.36 (1934)
Erie . . . . (Cleveland, Ohio)	571.98	572.30	572.01	570.44	572.51 (1973)	568.23 (1934)
Ontario . . . . (Oswego, N.Y.)	244.73	245.14	245.06	244.70	246.91 (1947)	241.94 (1934)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	September 30, 1980	September 30, 1979	Reference period 1904–79		
			September average, 1904–79	September maximum (year)	September minimum (year)
Elevation in feet above mean sea level:	4,199.10	4,197.65	4,197.70	4,203.70 (1923)	4,191.50 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1979): 102.1 (1869). Alltime low (1939–1979): 92.17 (1941).	September 26, 1980	September 30, 1979	Reference period 1939–78		
			September average, 1939–78	September max. daily (year)	September min. daily (year)
Elevation in feet above mean sea level:	95.04	95.50	94.63	97.79 (1976)	92.91 (1941)

FLORIDA

Site	September 1980		August 1980	September 1979
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	767	93	820	750
Miami Canal at Miami (southeastern Florida)	150	38	104	400
Tamiami Canal outlets, 40-mile bend to Monroe	864	160	121	414

(Continued from page 6.)
northern part of the Lower Peninsula, monthly mean flow of Muskegon River at Evart (drainage area, 1,450 square miles) increased sharply into the above-normal range and the mean discharge of 740 cfs was the 7th highest for September in 48 years of record. Also in this part of the State, monthly mean levels of Crooked Lake near Conway, Houghton Lake near Houghton Lake Heights, and Lake Mitchell-Cadillac at Cadillac were, respectively, 0.40 foot, 0.13 foot, and 0.45 foot above normal. In the Upper Peninsula, monthly mean flow of Sturgeon River near Sidnaw also increased sharply into the above-normal range and was 476 percent of the median discharge for the month. Also in the Upper Peninsula, the average monthly level of Lake Michigamme was 0.5 foot above the 25-year median level for September.

In Ohio, monthly mean discharges decreased seasonally at all index stations but remained in the above-normal range. For example, in the northeastern and central parts of the State, respectively, monthly mean flows of Little Beaver Creek near East Liverpool and Scioto River at Higby remained above the normal range for the 4th consecutive month and were about 4 times their respective median discharges for the month. In the northwestern part of the State, mean flow of Maumee River at Waterville also remained above the normal range for the 4th consecutive month and was 3 times median. Storage at monthend in reservoirs in the Mahoning River basin upstream from Newton Falls was 17 percent less than at the end of August, 9 percent less than a year ago, and 52 percent of capacity. Storage at monthend in reservoirs in the Scioto River basin upstream from Higby was 28 percent less than at the end of August, 40 percent less than a year ago, and 76 percent of normal capacity.

In Indiana, monthly mean flows remained above the normal range in all parts of the State except in the Mississinewa River in northern Indiana where mean discharge at Marion decreased sharply into the normal range, after 3 consecutive months in the above-normal range. In the southeastern and western parts of the State, respectively, monthly mean discharges of East Fork White River at Shoals and Wabash River at Mount Carmel, Ill., decreased seasonally and remained above the normal range for the 2d consecutive month.

In extreme southern Illinois, monthly mean flow of Skillet Fork at Wayne City increased slightly but remained in the below-normal range for the 5th consecutive month and was only 9 percent of median. Cumulative runoff for the 1980 water year was only 48 percent of median at this index station. In the central part of the State, mean discharge of Sangamon River at Monticello continued to decrease seasonally and remained within the normal range. In northern Illinois, mean discharge of Rock River near Joslin increased sharply, contrary to the normal seasonal pattern, was 4 times median, and remained above the normal range. Flow in Pecatonica River at Freeport, tributary to Rock River, was 2 times the September median discharge, and was above the normal range.

GROUND-WATER CONDITIONS

Ground-water levels in shallow water-table wells in Minnesota declined in the southern part of the State but continued to rise in the north; levels continued below average. In the Minneapolis-St. Paul area, artesian levels rose in wells tapping the Prairie du Chien-Jordan and in the deeper Mt. Simon-Hinckley aquifers in response to decreased pumping for air conditioning; levels in both were above average.

Levels generally rose in most of Wisconsin owing to above-normal precipitation. The most significant rises occurred in the southern half of the State. Levels in wells in heavily-pumped metropolitan areas declined and were below normal.

Levels in observation wells in Michigan generally rose and were above normal in most parts of the State. Levels were below normal in the southeastern and south-central Michigan.

In Illinois, the level in the shallow well in glacial drift at Princeton, in Bureau County, rose 1.6 feet and continued above average by more than 5 feet.

In Indiana, levels declined in key wells in the southern part of the State but held steady in the north.

In Ohio, levels declined but continued above normal in both the northeastern and central parts of the State.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow increased in Missouri and North Dakota, decreased in Saskatchewan, Arkansas, Kansas, Louisiana, and Oklahoma, and was variable elsewhere in the region. Monthly mean flows remained in the below-normal range in parts of Arkansas, Kansas, Louisiana, Nebraska, North Dakota, Oklahoma, and Texas. Mean flows persisted in the above-normal range in parts of Iowa and Texas. Flooding occurred in Texas.

Ground-water levels rose in Nebraska, but trends were mixed in other States in the region. Levels were below average in Kansas and Arkansas, and mostly below average in Texas. Levels were above average in Nebraska, mostly above average in Iowa, and mixed with respect to

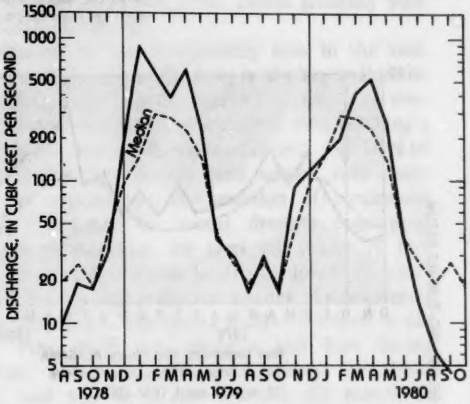
average in other States. New low levels for September were recorded in Arkansas, Louisiana, and Texas.

STREAMFLOW CONDITIONS

Runoff from rains of as much as 20 inches, associated with tropical storm Danielle, was reported by the National Weather Service to have caused flooding along the North and South Forks of Llano River, and along the Colorado, San Saba, San Antonio, Frio, and Neuces Rivers, in southwestern and south-central Texas during the 2d week in September. Increased runoff in North Concho River in western Texas, during this period resulted in monthly mean flow at the index station near Carlsbad that was 244 times the median discharge for September, and in south-central Texas, monthly mean flow of Guadalupe River near Spring Branch also increased sharply and was in the above-normal range for the first time since August 1979. Near monthend, the National Weather Service reported moderate flooding along Devils River from Juno to Bakers Crossing (Val Verde County) in western Texas. Many roads were reported closed in Val Verde County at that time. Flooding also was reported in coastal and southern parts of the State as a result of rapid runoff of intense rainfall, and in north-central Texas, flooding of roads and homes was reported in Haskell and Jones Counties. In extreme eastern Texas, mean flow of Neches River near Rockland decreased seasonally and was in the below-normal range for the 2d time in the past 3 months. Below-normal flows were reported to have occurred also in parts of the Brazos, Trinity, and Sabine River basins.

In northwestern Louisiana, extreme drought conditions were reported during September. For example, no flow was observed in Paw Paw Bayou near Greenwood (drainage area, 78 square miles) during the entire month. This was the 6th occurrence of zero flow conditions during September since records began in October 1955 at this site. Also, in this part of the State, the monthly mean discharge of 4.3 cfs in Saline Bayou near Lucky (drainage area, 154 square miles) was the lowest for the entire period of record beginning June 1940. (See graph.) The daily mean discharge of 3.4 cfs on September 19, 20, at that station was lowest for the month in the 40-year record. In the west-central part of the State, mean flow of Calcasieu River near Oberlin decreased, contrary to the normal seasonal pattern, and was in the below-normal range for the first time since December 1978. Monthly mean discharges of Red River at Alexandria and Mississippi River at Baton Rouge were 85 percent and 139 percent of the respective median flows at those 2 sites.

In southern Arkansas, monthly mean flow of Saline River near Rye decreased sharply but remained in the



Monthly mean discharge of Saline Bayou near Lucky, La. (Drainage area, 154 sq mi; 399 sq km)

normal range for the 5th consecutive month. By contrast, in the northern part of the State, mean flow of Buffalo River near St. Joe remained in the below-normal range for the 3d consecutive month and was only 22 percent of the median discharge for September.

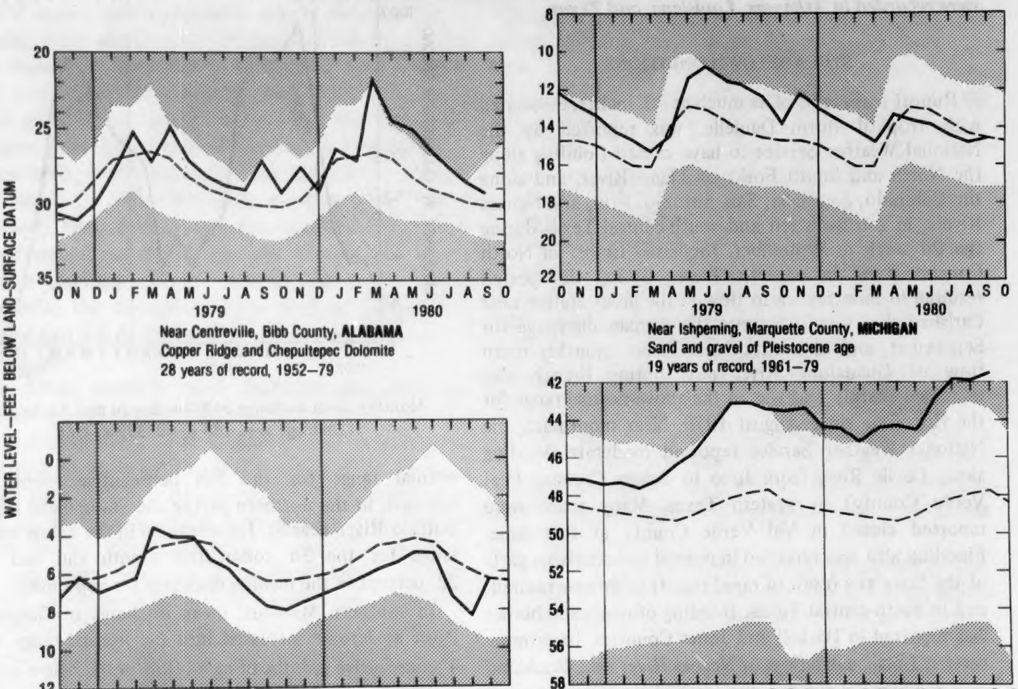
In southern Missouri, mean discharge of Gasconade River at Jerome increased into the normal range, after 4 consecutive months of mean flow in the below-normal range, but continued to be less than median. Mean flows of some headwater streams in this part of the State reached the 10-year low-flow frequency level during September, and drought conditions were reported to be slightly improved in some small areas. In the northwestern part of the State, monthly mean discharge of Grand River near Gallatin increased, contrary to the normal seasonal pattern, and was 2½ times the September median flow.

In the nearby areas of southwestern Iowa, monthly mean discharge of Nishnabotna River above Hamburg decreased seasonally but remained in the normal range for the 4th consecutive month and also remained above median. By contrast, monthly mean flow of Des Moines River at Fort Dodge, in the north-central part of the State, continued to increase, in contrast to the normal seasonal pattern, was 3½ times the September median flow and was in the above-normal range. In eastern Iowa, monthly mean discharge of Cedar River at Cedar Rapids decreased seasonally but remained in the above-normal range for the 3d time in the past 4 months and was over 3 times the median discharge for the month. (See graph on page 10.)

In southwestern Oklahoma, monthly mean flow of Washita River near Durwood decreased, contrary to the normal seasonal pattern, remained in the below-normal

MONTH-END GROUND-WATER LEVELS IN KEY WELLS

UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR THE MONTH
DOTTED LINE INDICATES AVERAGE OF MONTHLY LEVELS, IN PREVIOUS YEARS
HEAVY LINE INDICATES LEVEL FOR CURRENT PERIOD

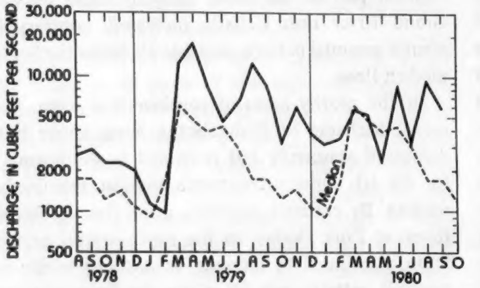


Near Centreville, Bibb County, **ALABAMA**
Copper Ridge and Chepultepec Dolomite
28 years of record, 1952–79

Near Ishpeming, Marquette County, **MICHIGAN**
Sand and gravel of Pleistocene age
19 years of record, 1961–79

Near Ashland, Saunders County, **NEBRASKA**
Sand and gravel deposits of Pleistocene age
47 years of record, 1933–79

Near Blanding, San Juan County, southeastern **UTAH**
Drilled stock artesian well
21 years of record, 1960-80



Monthly mean discharge of Cedar River at Cedar Rapids, Iowa
(Drainage area, 6,510 sq mi; 16,861 sq km)

range, and was only 7 percent of median. Water rationing was reported to have been continued in many communities in the State during September. Reservoir storage at monthend generally was below average for the month.

In Kansas, streamflow decreased sharply in all parts of the State as a result of below-normal precipitation and above-normal temperatures. For example, in southwestern Kansas, mean flow of Arkansas River at Arkansas City decreased to 16 percent of median and was below the normal range for the 3d time in the past 4 months. Similarly, in northeastern Kansas, mean flow of Little Blue River near Barnes decreased to 13 percent of median and was in the below-normal range for the 3d consecutive month. In the northwestern part of the State, monthly mean discharge of Saline River near Russell also decreased sharply, contrary to the normal seasonal pattern, and was only one-third of the September median flow, but remained within the normal range.

In northeastern Nebraska, monthly mean flow of Elkhorn River at Waterloo was only 41 percent of the September median discharge and remained in the below-normal range for the 3d consecutive month. By contrast,

in the Nebraska Panhandle, mean discharge of Niobrara River above Box Butte Reservoir was 125 percent of median and remained in the normal range for the 4th consecutive month. Also, in western Nebraska, mean flow of North Platte River was reported to be normal. In the north-central part of the State, streamflow remained below normal, and in the Republican River basin in southwestern Nebraska, all streamflow was reported to be much below normal.

In central South Dakota, flow in Bad River near Fort Pierre ceased on July 15 and had not resumed at the end of September. In the eastern part of the State, mean flow of Big Sioux River continued to decrease seasonally but remained in the normal range for the 7th consecutive month.

In southwestern North Dakota, mean flow of Cannonball River at Breien increased slightly but remained in the below-normal range for the 5th time in the past 7 months. In the eastern part of the State, monthly mean discharge of Red River of the North at Grand Forks also increased but remained below the normal range for the 5th consecutive month. Elsewhere in the State, streamflow was reported to be in or above the normal range as a result of two months of abundant rainfall.

In southeastern Saskatchewan, monthly mean flow of Qu'Appelle River near Lumsden decreased slightly but was 221 percent of median, and in the above-normal range for the first time since July 1979.

In southwestern Manitoba, the level of Lake Winnipeg at Gimli averaged 713.88 feet above mean sea level for the month, the same as the long-term mean for September, 0.11 foot higher than last month, 0.71 foot lower than a year ago, 3.37 feet lower than the maximum average level for September, that occurred in 1974, and 3.76 feet higher than the minimum average level for the month, that occurred in 1941. Records of Lake Winnipeg levels were started in May 1913 at Winnipeg Beach.

GROUND-WATER CONDITIONS

In North Dakota, ground-water levels rose in the western part of the State and declined in the east. Levels were below average in the east and west, but were at or above normal in the central third of the State.

Water levels in Nebraska rose in most of the observation wells and were near or slightly below long-term averages at month's end.

Water levels in shallow water-table wells in Iowa rose and were above average in most parts of the State. The level in one well in southwestern Iowa declined and was below average.

In Kansas, levels rose in key wells in the northwestern part of the State and declined in the northeast, and declined in two other key wells. Levels generally were below average statewide.

In Arkansas, in the rice-growing area in the east-central part of the State, the level in the key well in the shallow Quaternary aquifer declined slightly and continued below average by more than 6½ feet, reaching a new September low in 51 years of record. The level of the well in the deep Sparta Sand aquifer rose about 33 feet in response to the cessation of continuous pumping occasioned by recent drought conditions; despite the marked rise, the level was nearly 70 feet below average, and at a new September low in 13 years of record. In the key industrial aquifer of central and southern Arkansas—the Sparta Sand—the level in the well at Pine Bluff rose about a half foot during September, but continued below average by about 37 feet, and was at a new low for the month in 22 years of record.

In Louisiana, water levels in the Chicot aquifer in the southwest continued to recover following the irrigation season, except at Opelousas and Lafayette, where declines have persisted for 4 months. Despite a rise of more than 4 feet in well JD-485, near Iowa, La., the artesian level in the Chicot aquifer was at a new September low in 40 years of record. In the Lake Charles industrial area, levels generally rose, ranging up to 21½ feet in the 500-foot sand, and from 1 to 3 feet in the 700-foot sand. However, levels in wells in the 200-foot sand declined ½ to 4 feet. In the northern and central areas, levels in wells in the Sparta Sand and in the Miocene aquifers continued to decline regionally. Water levels in wells in the Wilcox, Cockfield, Terrace, and alluvial aquifers showed normal seasonal declines. In the Baton Rouge area, levels in the upper strata rose but in the lower group there were seasonal declines. In the Florida parishes, levels in the shallow sands have generally held steady during the last 5 years; in the deep sands, however, declines are continuing.

In Texas, in the artesian Edwards Limestone aquifer, the level in the key well at Austin declined but was above average, whereas the level in the well at San Antonio rose but was below average. The artesian level in the key well in the Evangeline aquifer at Houston declined 9½ feet, reaching a new September low in 15 years of record. Despite a rise of nearly a foot in the key water-table well in the bolson deposits at El Paso, the level was at a new September low in 15 years of record.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

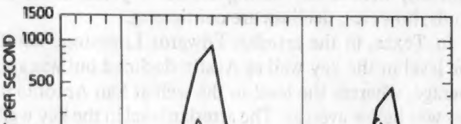
Streamflow generally decreased seasonally in Alberta, British Columbia, California, Colorado, Nevada, and

Wyoming, increased in Washington, and was variable elsewhere in the region. Monthly mean flows remained above the normal range in parts of California, Nevada, and Utah, and increased into that range in parts of Arizona, Idaho, Montana, New Mexico, Oregon, and Washington. Mean flows remained in the below-normal range in parts of Arizona, Oregon, and Utah, and decreased into that range in parts of California and New Mexico. Mean flows were highest of record for the month in parts of Utah.

Ground-water levels rose in Washington, Utah, and in most areas in Idaho; in other States, trends were generally mixed. Levels were below average in Washington, Arizona, and in most of Idaho and New Mexico, and above and below average in other States in the region. New high levels for September were recorded in southern California and Nevada, and new September low levels occurred in Idaho, where last year's September low was equalled in one well. Two new alltime low levels were recorded in Arizona.

STREAMFLOW CONDITIONS

In southeastern New Mexico, where flow of Delaware River near Red Bluff was below the normal range and only 11 percent of median in August, monthly mean flow increased sharply as the result of a late-month storm, was above the normal range, and was 26½ times the median discharge for September. In the north-central part of the State, where flow at Pecos River near Pecos was below the normal range in August, the seasonal decrease in flow was less than normal, and mean discharge in September was below median but within the normal range. (See graph.) In northern New Mexico,



Monthly mean discharge of Pecos River near Pecos, N.Mex. (Drainage area, 189 sq mi; 490 sq km)

mean discharge of Rio Grande below Taos Junction Bridge, near Taos, continued to decrease seasonally and was below the normal range for the first time since December 1979. Runoff for the 1980 water year was above median throughout the State.

In southwestern Colorado, monthly mean discharge of Animas River at Durango increased, contrary to the normal seasonal pattern of decreasing flows, was 1½ times median, but remained in the normal range for the 3d consecutive month. Elsewhere in the State, streamflow at index stations decreased seasonally and was near median.

In southwestern Utah, the monthly mean flow of 57.6 cfs, and the daily mean of 84 cfs on the 7th, in Beaver River near Beaver (drainage area, 90.7 square miles) were highest for the month in 68 years of record and marked the 4th consecutive month of record high flows at that site. By contrast, in the northeastern part of the State, monthly mean flow of Green River at Green River continued to decrease seasonally and remained in the below-normal range for the 2d consecutive month and was only 42 percent of median. Elsewhere in the State, monthly mean flows at index stations were near or slightly greater than median but within the normal range.

Contents of the Colorado River Storage Project decreased 629,070 acre-feet during the month.

In Wyoming, streamflow decreased seasonally and was within the normal range and near median at both index stations.

In adjacent Montana, monthly mean discharge of Yellowstone River at Billings increased, contrary to the normal seasonal pattern, and was above the normal range at 141 percent of median. Similarly, in the northwestern part of the State, mean flow of Middle Fork Flathead River near West Glacier increased and was above the normal range following 3 months when flows were below median. In western Montana, monthly mean flow of Clark Fork at St. Regis also increased, was 118 percent of median, and was above the normal range for the first time since September 1978. Elsewhere in the State, monthly mean flows decreased seasonally at index stations but remained in the normal range. Runoff for the 1980 water year and for the period April to September was within the normal range at all 5 index stations.

In southern Idaho, where monthly mean discharge of Snake River at Weiser was 11 percent below the median flow in August, flow increased sharply, was 11 percent above the September median discharge, and 46 percent above the mean flow for August. In the central part of the State, monthly mean flow of Salmon River at White Bird increased, contrary to the normal seasonal pattern of decreasing flow, and was above the normal range for the first time in 2 years. In northern Idaho, the seasonal

decrease in streamflow at Clearwater River at Spalding was less than normal and flow at that site was above the normal. range for the second time since May 1979. Runoff for the 1980 water year was in the normal range except for the Clearwater, Coeur d'Alene, and Kootenai Rivers (all in northern Idaho) which were in the below-normal range. Reservoir storage was generally above average.

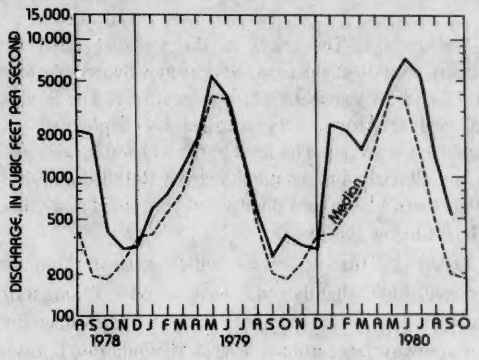
In Alberta and British Columbia, monthly mean flows at index stations decreased seasonally, were in the normal range, and were equal to or slightly greater than the median flows for September.

In northwestern Washington, mean flow of Skykomish River near Gold Bar increased sharply to 1½ times median and was above the normal range for the first time since April 1980. Elsewhere in the State, streamflow was generally above median but within the normal range. Storage in all five index reservoirs ranged between 97 and 111 percent of last year and of their long term averages.

In north-central Oregon, monthly mean discharge of John Day River at Service Creek increased seasonally, was above the normal range, and remained above median for the 4th consecutive month. In the western part of the State, mean flows of Willamette River at Salem and Umpqua Rivers near Elkton decreased seasonally, were 68 and 87 percent of their respective median flows, and remained in the below-normal range.

In north-coastal California, monthly mean discharge of Smith River near Crescent City decreased to 88 percent of median and was below the normal range. Also in northern California, mean flow of Sacramento River at Verona increased seasonally, was 138 percent of median, and remained in the above-normal range for the 3d consecutive month. On the central Sierra Nevada east slope, monthly mean flow of West Walker River below Little Walker River, near Coleville, decreased seasonally to 189 percent of median but remained in the above-normal range for the 3d consecutive month. In the southern part of the Sierra Nevada west slope, mean flow of Kings River above North Fork, near Trimmer, continued to decrease seasonally, but remained in the above-normal range for the 4th consecutive month and was over 2½ times median. (See graph.) In southern California, monthly mean discharge of Arroyo Seco near Pasadena also continued to decrease seasonally, but because of high carryover flow, remained in the above-normal range for the 9th consecutive month. Combined contents of 10 index reservoirs in northern and central California was 123 percent of average, and 120 percent of the contents one year ago.

In north-central Nevada, monthly mean flow of Humboldt River at Palisade was 2½ times median and



Monthly mean discharge of Kings River above North Fork, near Trimmer, Calif. (Drainage area, 952 sq mi; 2,466 sq km)

remained in the above-normal range for the 5th consecutive month. In extreme southeastern Nevada and the adjacent areas of Utah and Arizona, mean flow of Virgin River as measured at Littlefield, Ariz., increased, contrary to the normal seasonal pattern, and was above the normal range for the 8th time in the past 9 months. Cumulative runoff for the 1980 water year and the period April to September at that site was more than 3 times median and above the normal range.

In southern Arizona, monthly mean flow of San Pedro River at Charleston decreased seasonally and remained in the below-normal range for the 3d consecutive month. Elsewhere in the State, mean flows increased at some index stations and decreased at others but flows were generally below median and within the normal range. Annual runoff for the 1980 water year was below the normal range and only 32 percent of median in the San Pedro River at Charleston. Conversely, runoff for the 1980 water year at the remaining index stations in the State was above the normal range and ranged from 213 percent of median at Little Colorado River near Cameron to 376 percent of median at Verde River below Tangle Creek, above Horseshoe Dam.

GROUND-WATER CONDITIONS

In Washington, the artesian ground-water level in the key well in Tacoma, in the western part of the State, rose slightly but was 11 feet below average. The level in the well in Spokane Valley, in eastern Washington, also rose slightly but was 5 feet below average.

In Idaho, the level in the well in the sand and gravel water-table aquifer in the Boise Valley continued its seasonal decline but was slightly above average. In the non-artesian key wells representative of the conditions in the Snake River Plain aquifer, the levels rose but were

below average. The levels in the wells at Eden and Rupert, despite slight rises, were at new September lows in 23 and 30 years of record, respectively. The level in the well at Atomic City equalled the September low reached a year ago. The level in the key water-table well in the alluvial aquifer underlying the Rathdrum Prairie, in northern Idaho, rose slightly but continued more than 10 feet below average.

Levels in the key water-table wells in Montana changed only slightly and were close to long-term averages. The level at Hamilton Fairgrounds declined but was above average, and the level at Missoula rose but was below average.

In southern California, levels generally followed seasonal patterns except for the well at Los Alamitos in Orange County, where the artesian level rose 13½ feet. The level in the key well in Upper Cuyama Valley declined 5 feet, but nevertheless was at a new September high in 30 years of record.

In Nevada, the artesian levels in key wells in Las Vegas Valley and Truckee Meadows rose slightly but continued below average. The artesian level in the well in Paradise Valley declined and was below average. Despite a very slight decline, the level in the artesian key well at Steptoe Valley was at a new September high in 30 years of record.

In Utah, levels rose but were below average in the Flowell and Holladay areas, and rose and were above average in the Logan and Blanding areas.

In Arizona, the level declined in the City of Tucson No. 2 observation well, and was 23 feet below average. Two alltime lows were reported in the State; one of these was in the key well in the Elfrida area, where the level held steady but again was at an alltime low in 29 years of record.

In New Mexico, the level rose in the Berrendo-Smith artesian observation well in the Roswell basin, and was above average. Levels rose in the Hrna well in the Mimbres Valley, and declined in the Dayton and Hagerman-West wells in the Roswell Basin, and in the Lovington well in the High Plains of southeastern New Mexico. Levels in these four wells were below average; all are water-table wells.

ALASKA

In south-central Alaska, localized flooding in the Talkeetna Mountains occurred at midmonth as a result of runoff from rains in excess of 3 inches in the area. Monthly mean flow of Little Susitna River near Palmer (drainage area, 61.9 square miles) decreased seasonally but remained in the above-normal range for the 4th consecutive month, and the daily mean discharge of 2,900 cfs on the 15th was highest for September in 23 years of record. In south-coastal Alaska, monthly mean discharge of Kenai River at Cooper Landing continued to decrease seasonally and was below median but within the normal range, following 11 consecutive months of flows in the above-normal range. Annual mean flows for the 1980 water year at both sites were second highest for period of record. In the interior, monthly mean flow of Chena River at Fairbanks increased seasonally and was above median for the first time since April, while mean flow at Tanana River at Nenana, which is glacier-fed, decreased seasonally as a result of cooler temperatures; flows at both sites were within the normal range. In southeastern Alaska, monthly mean flow of Gold Creek at Juneau decreased seasonally and was only slightly above median.

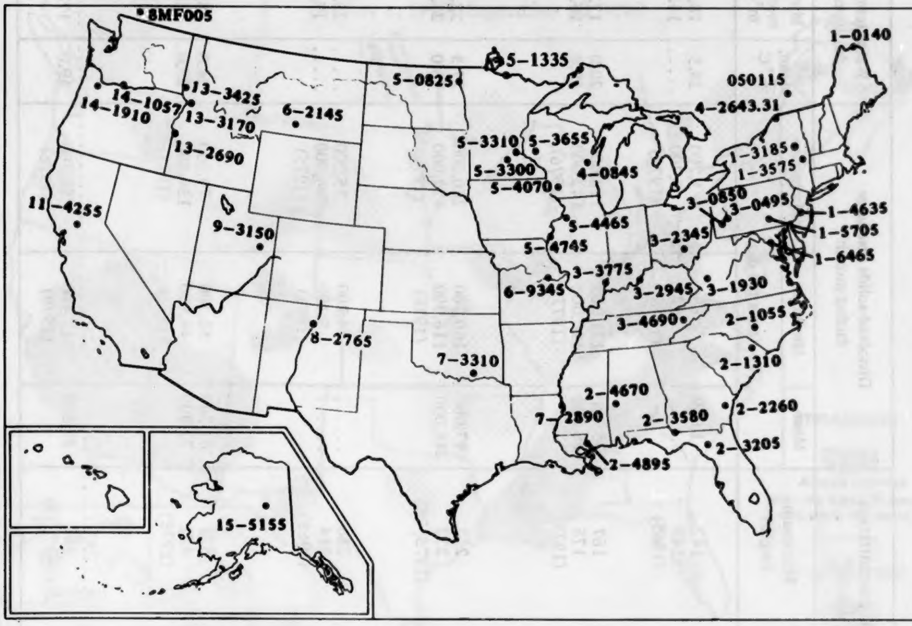
Ground-water levels continued to rise in wells tapping the confined system throughout the Anchorage area. Most levels were between ½ and 1½ feet higher than last month.

HAWAII

Streamflow was variable throughout the State but was above the normal range at all index stations. For example, on the islands of Hawaii and Kauai, where monthly mean flows in Waiakea Stream near Mountain View (island of Hawaii), and East Branch of North Fork Wailua Stream near Lihue (island of Kauai), respectively, were below the normal range in August, mean flows increased sharply into the above-normal range and were two times the respective median flows for September. By contrast, on the islands of Maui and Oahu, monthly mean flows decreased seasonally but, because of increased runoff during the last half of the month, were in the above-normal range and were 190 percent and 193 percent of their respective median discharges.

On Guam, Mariana Islands, monthly mean flow of Ylig River near Yona (drainage area, 6.48 square miles) increased sharply into the above-normal range and was 1½ times the median flow for the month. The daily mean discharge of 1,115 cfs on the 9th was the highest for September at that station since records began in 1952, and also was highest for any month except October, for which the maximum observed daily mean discharge was 2,050 cfs in 1954.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 19.

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR SEPTEMBER ON SIX LARGE RIVERS

The table on page 16 shows dissolved-solids and temperature data for September at six stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). NASQAN, as established by the U.S. Department of the Interior, Geological Survey, is designed to describe the water quality of the Nation's streams and rivers on a systematic and continuing basis, so as to meet many of the information needs of those involved in national or regional water-quality planning and management.

"Dissolved solids," as described in several columns of the table, are minerals dissolved in water and usually consist predominantly of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. These same minerals are among the most common components of the Earth's solid rocks and minerals, but gradually erode and at least partly dissolve as a part of natural weathering processes. Collectively these and other dissolved minerals constitute the dissolved-solids concentration expressed in milligrams per liter (mg/L) or the generally equivalent expression, parts per million (parts of dissolved matter in one million parts of water, by weight). Values of dissolved solids are convenient for comparing the quality of water from one time to another and from one place to another. Most drinking water contains between 50 and 500 mg/L of dissolved solids.

"Dissolved-solids discharge," expressed in tons per day, represents the total daily amount of dissolved minerals carried by the stream and is calculated by multiplying the dissolved-solids concentration (in mg/L) by the stream discharge (in cfs; times a unit conversion factor of .0027). Even though dissolved-solids *concentrations* are generally higher during periods of low streamflow than of high streamflow, the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

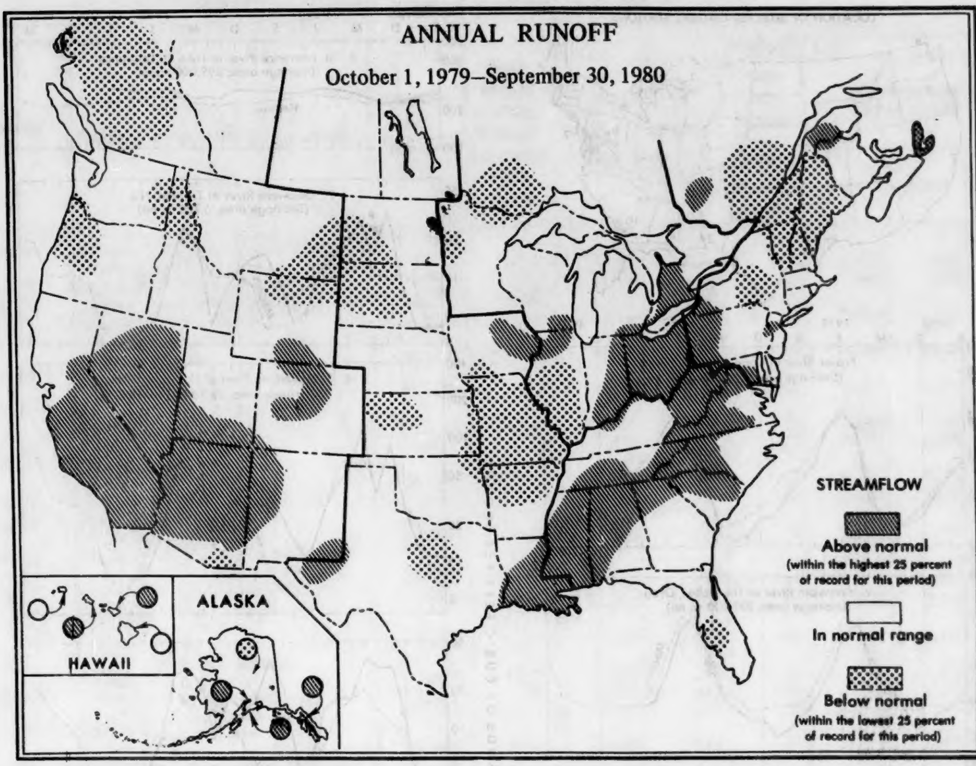
Provisional data; subject to revision

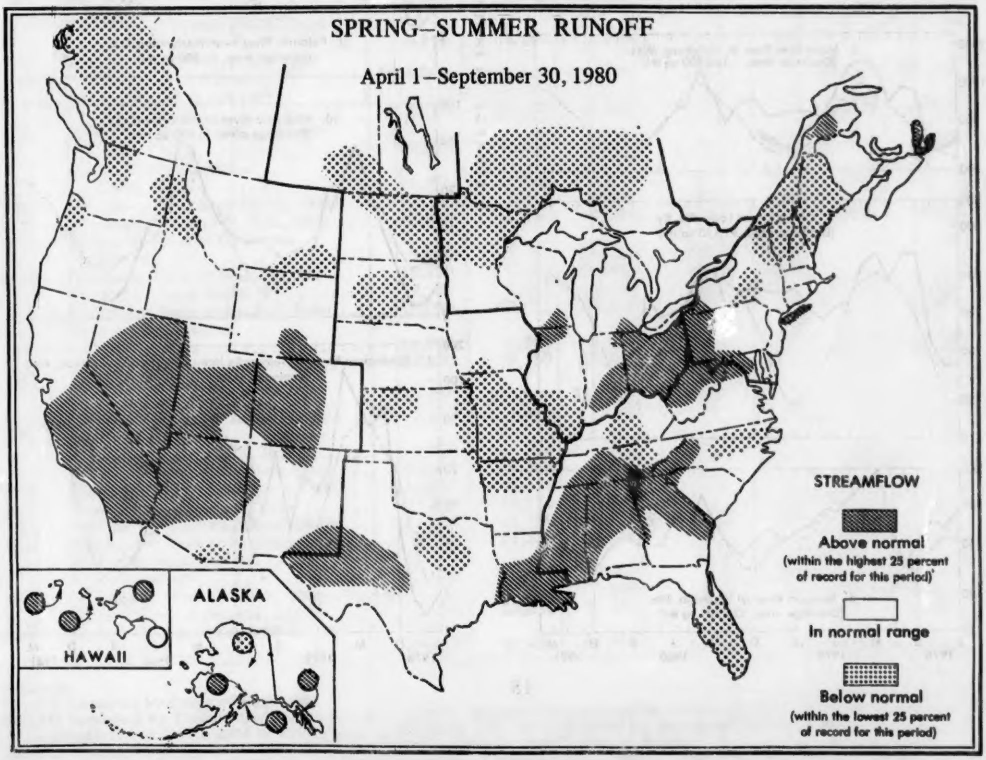
DISSOLVED SOLIDS AND WATER TEMPERATURES FOR SEPTEMBER AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	September data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month[b]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean (tons per day)	Minimum (tons per day)	Maximum (tons per day)	Mean, in °C	Minimum, in °C	Maximum, in °C
	NORTHEAST										
01463500	Delaware River at	1980	2,974	112	142	1,000	886	1,200	24.5	18.5	29.0
	Trenton, N.J.	1945–79	5,643	63	149	......	523	6,700	.....	14.0	32.0
	(Morrisville, Pa.)	(Extreme yr)		(1977)	(1965)		(1966)	(1974)			
			c4,176								
04264331	St. Lawrence River at	1980	301,000	164	167	135,000	131,000	138,000	20.0	17.5	22.5
	Cornwall, Ontario, near	1975–79	285,100	165	175	128,000	120,000	142,000	19.0	15.0	22.0
	Massena, N.Y.	(Extreme yr)		(1979)	(1979)		(1977)	(1976)			
	median streamflow at		c242,000								
	Ogdensburg, N.Y.										
	SOUTHEAST										
07289000	Mississippi River at	1980	333,800	205	233	197,000	160,000	260,000	27.5	22.5	29.0
	Vicksburg, Miss.	1975–79	384,500	185	272	246,000	116,000	472,000	26.0	21.0	30.0
		(Extreme yr)		(1977)	(1975, 78)		(1976)	(1979)			
			c248,200								
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam	*1980	94,100	160	286	......	24,200	75,200	.....	28.5	28.5
	53, near Grand Chain, Ill.	1955–79	115,500	117	314	......	9,190	304,000	.....	17.0	29.5
	(25 miles west of Paducah,	(Extreme yr)		(1965)	(1965)		(1961)	(1975)			
	Ky.; streamflow station		c78,480								
	at Metropolis, Ill.)										
	MIDCONTINENT										
06934500	Missouri River at Hermann,	1980	50,400	351	521	61,300	56,300	79,100	24.0	18.5	27.5
	Mo. (60 miles west of St.	1975–79	83,140	204	453	77,900	46,900	154,000	23.0	18.0	28.0
	Louis, Mo.)	(Extreme yr)		(1977)	(1978)		(1976)	(1977)			
			c52,580								
	WEST										
14128910	Columbia River at	**1980	90,400	....	....	.....	....	....	.....	.....	.....
	Warrendale, Oreg.	1975–79	123,100	73	102	29,800	17,400	50,300	19.0	17.0	21.5
	(streamflow station	(Extreme yr)		(1976)	(1977, 79)		(1979)	(1976)			
	at The Dalles, Oreg.)		c105,200								

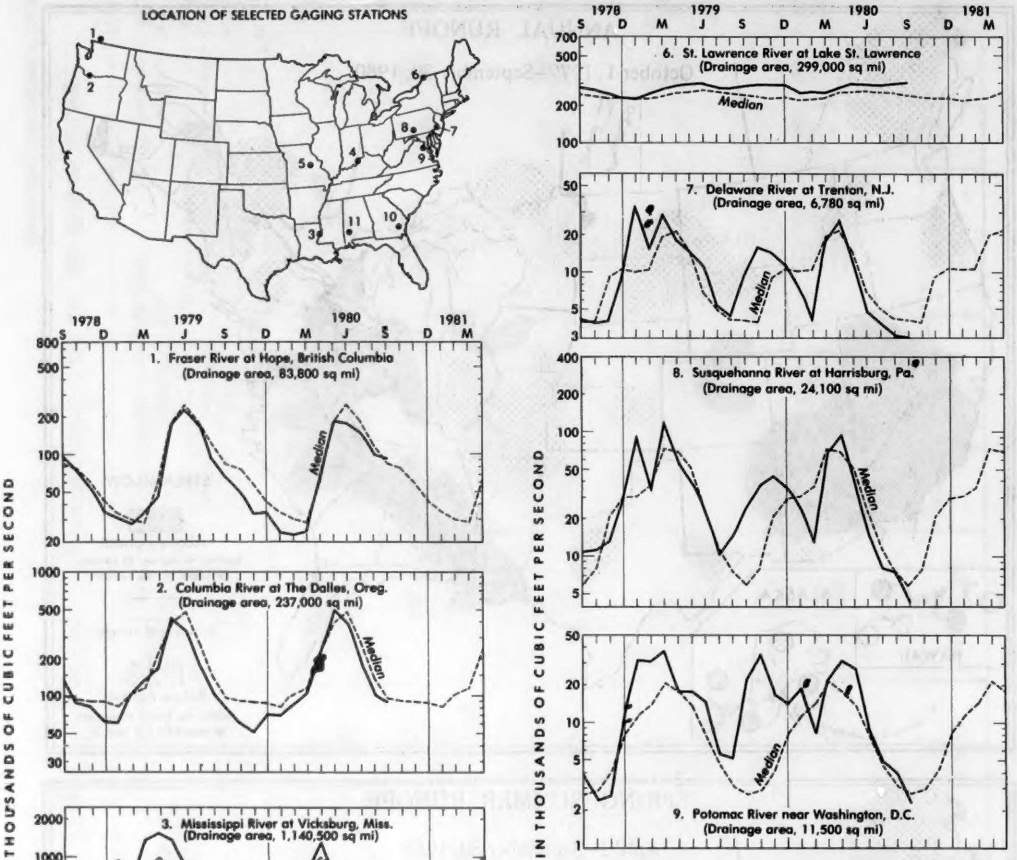
[a] Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b] To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c] Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.
*Water temperature records are for three days only (Sept. 9–11).
**Dissolved-solids and water-temperature records not available.

SUPPLEMENTAL DATA FOR WATER YEAR ENDING SEPTEMBER 30, 1980





HYDROGRAPHS OF SOME LARGE RIVERS, SEPTEMBER 1978 TO SEPTEMBER 1980



Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING SEPTEMBER 1980

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1975 (cfs)	September 1980: Monthly discharge (cfs)	September 1980: Percent of median monthly discharge, 1941–70	September 1980: Change in discharge from previous month (percent)	September 1980: Discharge near end of month (cfs)	September 1980: Discharge near end of month (mgd)	September 1980: Discharge near end of month Date
1–0140	St. John River below Fish River at Fort Kent, Maine	5,690	9,549	5,380	161	+21	8,400	5,430	30
1–3185	Hudson River at Hadley, N.Y	1,664	2,853	809	74	-1	840	540	30
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,630	1,346	84	-1	......	......	....
1–4635	Delaware River at Trenton, N.J	6,780	11,630	3,010	72	-6	2,910	1,880	25
1–5705	Susquehanna River at Harrisburg, Pa	24,100	34,200	4,400	75	-41	4,090	2,640	24
1–6465	Potomac River near Washington, D.C	11,560	[1]11,190	2,280	86	-42	2,260	1,460	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C	4,810	5,007	953	52	+18	1,200	780	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,657	3,030	65	-22	2,790	1,800	26
2–2260	Altamaha River at Doctortown, Ga	13,600	13,780	2,713	55	-21	2,710	1,750	27
2–3205	Suwannee River at Branford, Fla	7,880	6,970	3,580	64	-29	3,250	2,100	30
2–3580	Apalachicola River at Chattahoochee, Fla	17,200	22,330	9,740	80	-22	8,670	5,600	30
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala	15,400	22,570	3,232	100	-5	9,700	6,270	30
2–4895	Pearl River near Bogalusa, La	6,630	9,263	2,698	119	-17	2,530	1,640	30
3–0495	Allegheny River at Natrona, Pa	11,410	[1]19,210	10,900	399	-51	5,000	3,200	22
3–0850	Monongahela River at Braddock, Pa	7,337	[1]12,360	37,400	1,252	+59	24,450	15,800	22
3–1930	Kanawha River at Kanawha Falls, W.Va	8,367	12,530	4,800	150	-39	3,020	1,950	24
3–2345	Scioto River at Higby, Ohio	5,131	4,513	2,480	412	-77	1,700	1,100	25
3–2945	Ohio River at Louisville, Ky[2]	91,170	114,100	42,320	224	-72	22,180	14,300	28
3–3775	Wabash River at Mount Carmel, Ill	28,635	27,030	10,640	167	-37	8,920	5,770	30
3–4690	French Broad River below Douglas Dam, Tenn	4,543	[1]6,794	2,395	89	-12	......	......	....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis[2]	6,150	4,185	4,310	201	+40	......	......	....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y[3]	299,000	241,100	301,300	125	+3	296,000	191,300	30
050115	St. Maurice River at Grand Mere, Quebec	16,300	25,300	16,000	93	-25	24,600	15,900	30
5–0825	Red River of the North at Grand Forks, N. Dak	30,100	2,524	760	56	+72	500	320	30
5–1335	Rainy River at Manitou Rapids, Minn	19,400	12,950	5,910	55	+79	7,540	4,870	24
5–3300	Minnesota River near Jordan, Minn	16,200	3,412	1,190	107	-18	1,010	650	24
5–3310	Mississippi River at St. Paul, Minn	36,800	[1]10,580	7,280	115	+68	6,880	4,450	24
5–3655	Chippewa River at Chippewa Falls, Wis	5,600	5,110	12,000	398	+266	......	......	....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,613	22,300	383	+148	......	......	....
5–4465	Rock River near Joslin, Ill	9,551	5,852	10,600	412	+81	10,500	6,790	30
5–4745	Mississippi River at Keokuk, Iowa	119,000	62,570	100,000	243	+60	121,900	78,800	30
6–2145	Yellowstone River at Billings, Mont	11,796	6,986	5,630	141	+35	6,500	4,200	30
6–9345	Missouri River at Hermann, Mo	524,200	79,750	50,360	96	+5	43,000	27,800	24
7–2890	Mississippi River at Vicksburg, Miss[4]	1,140,500	573,600	333,800	134	-4	301,000	195,000	26
7–3310	Washita River near Durwood, Okla	7,202	1,414	34	7	-56	29	19	30
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex	9,730	724	218	82	-41	195	126	30
9–3150	Green River at Green River, Utah	40,600	6,366	956	42	-41	2,800	1,810	30
11–4255	Sacramento River at Verona, Calif	21,257	19,150	13,500	138	+5	12,900	8,340	24
13–2690	Snake River at Weiser, Idaho	69,200	18,170	13,960	111	+46	14,500	9,370	22
13–3170	Salmon River at White Bird, Idaho	13,550	11,290	5,475	125	+1	5,050	3,260	29
13–3425	Clearwater River at Spalding, Idaho	9,570	15,570	8,130	268	+54	10,500	6,790	22
14–1057	Columbia River at The Dalles, Oreg[5]	237,000	194,600	90,400	93	-13	......	......	....
14–1910	Willamette River at Salem, Oreg	7,280	23,810	2,690	68	-2	10,800	6,980	26–30
15–5155	Tanana River at Nenana, Alaska	25,600	23,850	27,270	86	-47	24,000	15,500	30
8MF005	Fraser River at Hope, British Columbia	83,800	96,400	91,800	111	-5	91,800	59,300	30

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

Provisional data; subject to revision

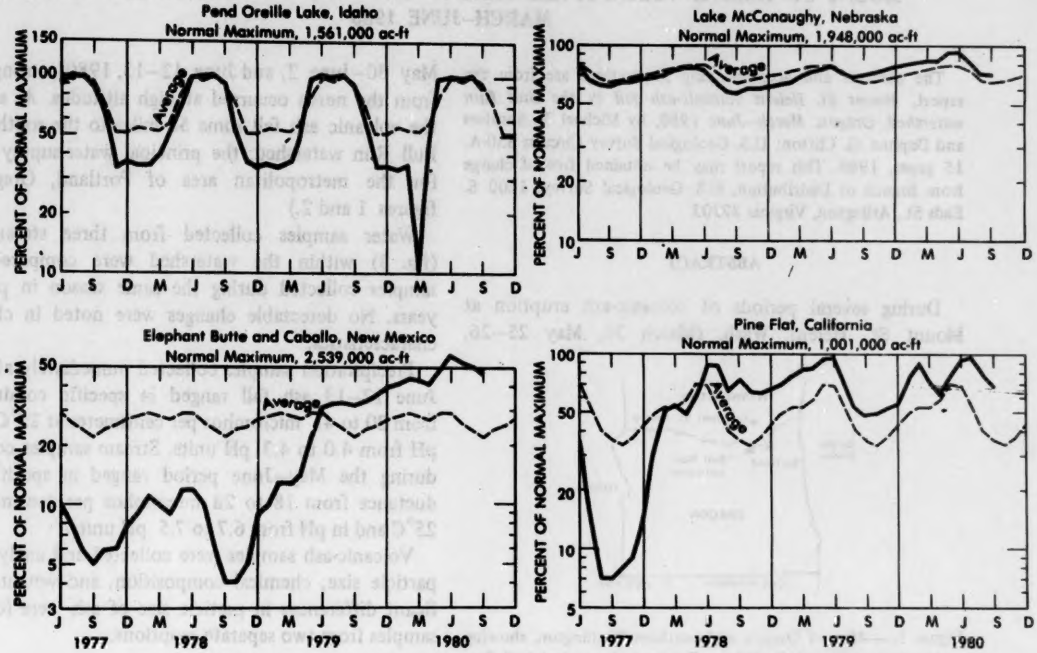
USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF SEPTEMBER 1980

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Aug. 1980	End of Sept. 1980	End of Sept. 1979	Average for end of Sept.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	53	45	65	39	226,300 (a)
QUEBEC					
Allard (P)	85	91	89	58	280,600 ac-ft
Gouin (P)	75	72	70	65	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	58	52	58	58	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	84	75	75	78	3,330 mcf
Lake Francis (FPR)	82	78	71	77	4,326 mcf
Lake Winnipesaukee (PR)	80	76	75	64	7,220 mcf
VERMONT					
Harriman (P)	74	66	70	64	5,060 mcf
Somerset (P)	75	73	76	72	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	74	69	75	74	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	71	62	66	62	34,270 mcf
Indian Lake (FMP)	94	86	98	58	4,500 mcf
New York City reservoir system (MW)	70	56	77	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	61	47	88	68	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	51	41	43	41	51,400 mcf
Pymatuning (FMR)	99	81	100	81	8,191 mcf
Raystown Lake (FR)	66	59	68	58	33,190 mcf
Lake Wallenpaupack (PR)	62	64	64	56	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	93	86	101	87	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	88	90	100	83	12,580 mcf
Narrows (Badin Lake) (P)	82	85	100	98	5,616 mcf
High Rock Lake (P)	71	56	100	65	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	84	82	83	68	70,300 mcf
Lakes Marion and Moultrie (P)	67	70	82	67	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	72	66	77	57	75,360 mcf
GEORGIA					
Burton (PR)	85	89	96	78	104,000 ac-ft
Sinclair (MPR)	90	86	95	81	214,000 ac-ft
Lake Sidney Lanier (FMPR)	55	51	64	55	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	88	85	88	76	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	41	31	49	38	1,156,000 cfsd
Douglas Lake (FPR)	38	25	64	34	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	66	56	72	59	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	37	43	67	45	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	63	54	74	58	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	74	94	75	73	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	64	92	57	63	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	23	24	30	32	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	82	81	91	93	22,700,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	71	66	91	74	127,600 ac-ft
Bell Fourche (I)	8	15	27	32	185,200 ac-ft
Lake Francis Case (FIP)	78	73	72	68	4,834,000 ac-ft
Lake Oahe (FIP)	75	73	90	.....	22,530,000 ac-ft
MIDCONTINENT REGION--Continued					
SOUTH DAKOTA--Continued					
Lake Sharpe (FIP)	102	98	102	99	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	95	94	96	97	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	72	72	71	65	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	80	76	96	80	2,378,000 ac-ft
Keystone (FPR)	84	73	91	95	661,000 ac-ft
Tenkiller Ferry (FPR)	89	84	103	90	628,200 ac-ft
Lake Altus (FIMR)	36	22	65	47	133,000 ac-ft
Lake O'The Cherokees (FPR)	79	70	76	81	1,492,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	85	80	98	92	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	21	21	44	45	386,400 ac-ft
Canyon (FMR)	88	91	90	70	385,600 ac-ft
International Amistad (FIMPW)	82	85	100	81	3,497,000 ac-ft
International Falcon (FIMPW)	75	72	100	74	2,668,000 ac-ft
Livingston (IMW)	86	84	100	80	1,788,000 ac-ft
Possum Kingdom (IMPRW)	82	77	93	100	570,200 ac-ft
Red Bluff (PI)	11	10	26	24	307,000 ac-ft
Toledo Bend (P)	88	84	89	80	4,472,000 ac-ft
Twin Buttes (FIM)	26	34	45	30	177,800 ac-ft
Lake Kemp (IMW)	44	36	55	86	268,000 ac-ft
Lake Meredith (FMW)	24	23	30	42	821,300 ac-ft
Lake Travis (FIMPRW)	73	85	87	76	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	97	92	93	91	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	102	100	94	103	5,022,000 ac-ft
Lake Chelan (PR)	95	88	85	85	676,100 ac-ft
Lake Cushman	96	94	98	91	359,500 ac-ft
Lake Merwin (P)	102	103	100	93	245,600 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	66	60	36	47	1,235,000 ac-ft
Coeur d'Alene Lake (P)	96	77	74	64	238,500 ac-ft
Pend Oreille Lake (FP)	100	86	88	92	1,561,000 ac-ft
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	62	57	37	47	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	90	83	79	83	802,000 ac-ft
Buffalo Bill (IP)	78	74	60	80	421,300 ac-ft
Keyhole (F)	57	54	78	47	190,400 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	64	56	54	42	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	15	13	1	12	364,400 ac-ft
Taylor Park (IR)	92	76	87	59	106,200 ac-ft
Colorado–Big Thompson project (I)	79	76	68	58	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	93	91	84	.....	31,620,000 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	88	83	67	59	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	69	69	73	58	1,000,000 ac-ft
Hetch Hetchy (MP)	95	83	71	58	360,400 ac-ft
Isabella (FIR)	76	61	38	26	568,100 ac-ft
Pine Flat (FI)	77	69	49	36	1,001,000 ac-ft
Clair Engle Lake (Lewiston) (P)	86	78	69	72	2,438,000 ac-ft
Lake Almanor (P)	95	94	67	51	1,036,000 ac-ft
Lake Berryessa (FIMW)	85	83	65	76	1,600,000 ac-ft
Millerton Lake (FI)	76	58	33	34	503,200 ac-ft
Shasta Lake (FIPR)	77	74	72	66	4,377,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	92	56	14	54	744,600 ac-ft
NEVADA					
Rye Patch (I)	93	89	53	52	194,300 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	90	90	85	71	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	69	66	78	12	1,073,000 ac-ft
Salt and Verde River system (IMPR)	79	75	78	36	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	42	40	47	85	330,100 ac-ft
Elephant Butte and Caballo (FIPR)	50	47	34	23	2,453,000 ac-ft

[a] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1977 TO SEPTEMBER 1980



Below-average contents characterized several key reservoirs in New Jersey, Oklahoma, South Dakota, and Texas during September. Monthend contents of many reservoirs in the West, however, were much above average, including Pine Flat Reservoir in California. (See graph above.)

WATER RESOURCES REVIEW

September 1980

Based on reports from the Canadian and U.S. field offices; completed October 15, 1980

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for September based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for September 1980 is compared with flow for September in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for September is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range*. In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the September flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of September. Water level in each key observation well is compared with average level for the end of September determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of August to the end of September.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

MOUNT ST. HELENS VOLCANIC-ASH FALL IN THE BULL RUN WATERSHED, OREGON, MARCH–JUNE 1980

The abstract and accompanying illustrations are from the report, *Mount St. Helens volcanic-ash fall in the Bull Run watershed, Oregon, March–June 1980,* by Michael V. Shulters and Daphne G. Clifton: U.S. Geological Survey Circular 850-A, 15 pages, 1980. This report may be obtained free of charge from Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, Virginia 22202.

ABSTRACT

During several periods of volcanic-ash eruption at Mount St. Helens, Wash. (March 30, May 25–26, May 30–June 2, and June 12–13, 1980), strong winds from the north occurred at high altitudes. As a result, the volcanic ash fell some 50 miles to the south in the Bull Run watershed, the principal water-supply source for the metropolitan area of Portland, Oreg. (See figures 1 and 2.)

Water samples collected from three stream sites (fig. 3) within the watershed were compared with samples collected during the same season in previous years. No detectable changes were noted in chemical characteristics.

Precipitation samples collected immediately after the June 12–13 ash fall ranged in specific conductance from 20 to 41 micromhos per centimeter at 25°C and in pH from 4.0 to 4.3 pH units. Stream samples collected during the May–June period ranged in specific conductance from 18 to 28 micromhos per centimeter at 25°C and in pH from 6.7 to 7.5 pH units.

Volcanic-ash samples were collected and analyzed for particle size, chemical composition, and weight. Significant differences in particle size of ash were found in samples from two separate eruptions.

Figure 1.—Map of Oregon and southern Washington, showing location of Mount St. Helens, Portland, Oreg., and Bull Run watershed.

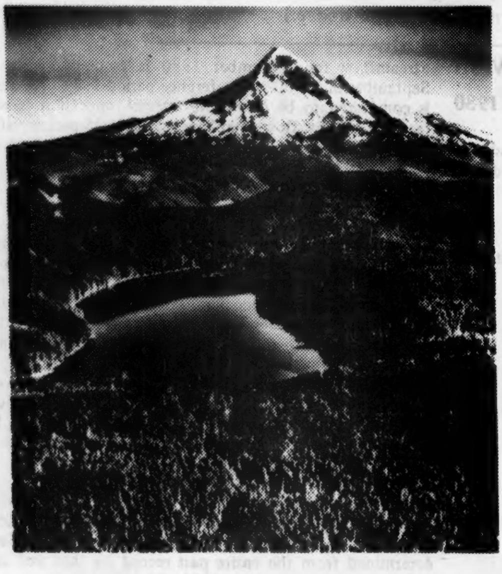

Figure 2.—Bull Run watershed, looking east toward Bull Run Lake and Mount Hood. (Photograph courtesy of U.S. Forest Service.)

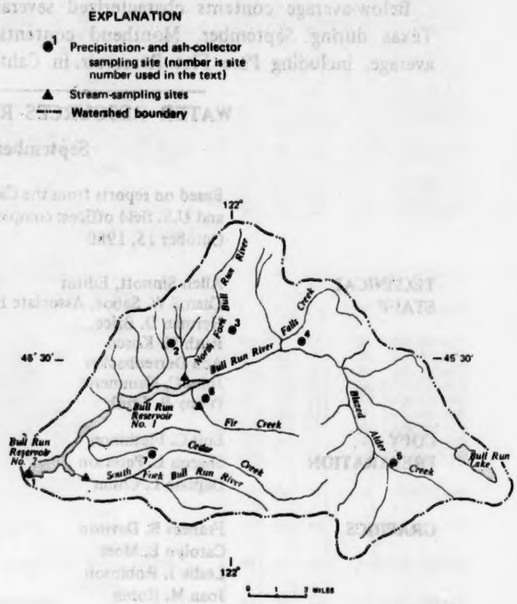

Figure 3.—Location of sampling sites in the Bull Run watershed.

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[illegible]

[illegible]

[illegible] As a result, [illegible]

[illegible]

[illegible]

[illegible]

[illegible]